STUDENT ATTENDANCE SYSTEM USING QR CODE

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Abstract - The Student Attendance System by QR Scan offers a modern and efficient method for tracking attendance in educational settings. Traditional manual attendance methods are often time-consuming and susceptible to errors, creating administrative challenges for both teachers and administrators. This system employs QR scanning technology to automate attendance recording and improve accuracy. It consists of three key components: QR code generation, scanning, and data management. By utilizing barcode scanning technology, the system swiftly and precisely captures attendance data, eliminating the need for manual records and minimizing human error. The Student Attendance System by QR Scan not only streamlines attendance management but also enhances student engagement and accountability. By automating this process, educators can dedicate more time to teaching, while students benefit from an accurate and efficient record-keeping system.

1. Introduction

Student Attendance System by QR Scan is a project designed to record student attendance using barcode technology. This innovative approach aims to automate the traditional attendance system through an authentication technique. The conventional method involves maintaining a register for manually marking student attendance, which is both time-consuming and prone to errors. This new system seeks to address these issues by offering a more efficient and accurate solution for attendance tracking . Hence this proposed project eliminates the need of maintaining attendance sheet.

The proposed system utilizes QR code technology to authenticate students through unique QR codes that represent their individual IDs. Each student is issued a card containing the QR code, which they scan using a barcode reader to record their attendance. The system logs the attendance data and stores all records, subsequently generating defaulter lists and reports for administrative use. This application is highly beneficial for both schools and colleges for daily attendance tracking.

1.1 - Problem Introduction

Lack of Immediate Retrievals: Retrieving specific information, such as a student's attendance history, is cumbersome and time-consuming with traditional systems, as it requires sifting through numerous registers.

Lack of Immediate Information Storage: Storing information generated by various transactions takes considerable time and effort to ensure it is placed correctly.

Lack of Prompt Updating: Making updates to information, such as student details, is challenging and slow due to the reliance on paperwork.

Preparation of Accurate and Prompt Reports: Collecting information from various registers to prepare accurate reports is a difficult and time-consuming task.

Objective:

1. **Define School/College:** Establish the basic framework and identity of the educational institution within the system.
2. **Record Student Information:** Capture and store detailed information about each student,

such as their personal details and enrolment status.

3. **Record Academic Information:** Maintain records related to the academic performance and activities of students.
4. **Track Student Attendance:** Keep accurate and up-to-date records of attendance sheet. attendance sheet. student attendance.

These tasks are currently managed manually by operational staff and professors, involving extensive paperwork and administrative effort. The proposed system aims to automate these processes, reducing manual work and improving efficiency.

Scope of the Project:

1. **Student Information Collection:** The system captures essential details such as the student's name, age, and gender. Each time a student interacts with the system, their information is freshly recorded and updated as needed.
2. **Document Management:** Traditionally, student information is recorded on paper documents, which are eventually destroyed to reduce paper clutter in the office. The new system aims to replace this method by digitally storing information, making it easier to manage and retrieve.
3. **Maintenance of Records:** Currently, student records are maintained in pre-formatted paper sheets stored in files. The project will digitize these records, ensuring they are stored securely and can be easily accessed and managed through the system.

All this work is done manually by the administrative office and other operational staff, requiring a lot of paper handling and management. Teachers also have to remember various details about students, which can lead to missed information.

1.2 – Modules

The entire project is divided into two main modules: Admin module and Student module.

Admin Module:
- **View Student List:** Allows the admin to view the list of all students.
- **Manage/View Student Attendance:** Provides the functionality to manage and view the attendance records of students.
- **Add New Student:** Enables the admin to add new students to the system.
- **Generate QR Code for Respective Student:** Generates a unique QR code for each student, which is used for attendance tracking.

Student Module:
- **Record Attendance:** Students can record their attendance by scanning their QR code.
- **Scan QR Code:** Provides the interface for students to scan their QR code using a barcode reader.
- **View Attendance:** Students can view their attendance records.

1. Literature Review

In recent years, the use of QR code technology has become increasingly popular in various fields, including education. One notable application is a student attendance system utilizing QR codes, which enhances efficiency and accuracy in tracking student attendance. This review examines related works and proposes an approach for developing a student attendance system using QR code technology.

QR Code-Based Attendance Systems

QR codes have gained traction in educational settings due to their simplicity and ease of use. Studies have shown that QR code-based systems significantly reduce the time and effort required for attendance tracking. These systems typically involve generating a unique QR code for each student, which the students scan upon entering the classroom. The scanned data is then automatically recorded in a database, minimizing the chances of errors and manipulation.

Comparison with Biometric Systems

While QR code technology is effective, it is essential to consider other attendance tracking methods, such as

biometric systems. Biometrics involves the measurement of unique human physiological or behavioral characteristics to verify user identity. Common biometric systems include fingerprint scanning, facial recognition, and iris recognition. These systems offer a higher level of security and accuracy by ensuring that the individual present is indeed the registered user.

One proposed biometric system uses facial recognition technology to monitor authenticated users or students throughout a session. This system continuously verifies the presence of the student by capturing and analyzing facial features. Although biometric systems provide robust security, they can be more complex and costly to implement compared to QR code-based systems.

Mobile-Based Attendance Tracking

An alternative approach to attendance tracking involves the use of mobile technology. One prototype system described in recent literature involves installing software on the instructor's mobile phone, enabling it to query students' mobile phones via Bluetooth. By transferring the Media Access Control (MAC) addresses of the students' mobile devices to the instructor's phone, the system can confirm the presence of students in the classroom. This method leverages existing mobile technology and infrastructure, making it a feasible option for many educational institutions.

Conclusion

The literature indicates a growing trend towards automated attendance systems in educational settings, with QR code and biometric technologies offering viable solutions. QR code-based systems are particularly advantageous due to their simplicity, cost-effectiveness, and ease of implementation. However, biometric systems provide a higher level of security and accuracy, albeit at a higher cost and complexity. Mobile-based systems present a middle ground, utilizing readily available technology to achieve accurate attendance tracking. Each method has its strengths and weaknesses, and the choice of system depends on the specific needs and resources of the educational institution.

This research paper explores the development and implementation of a student attendance system leveraging QR codes within a mobile application. The system was tested on a sample group of students, demonstrating its efficiency and effectiveness.

Background

Advancements in mobile computing, Information and Communication Technology (ICT), and behavioral science have significantly enhanced the educational landscape in India. The proposed system integrates these advancements to streamline attendance management in educational institutions.

Methodology

The project involves creating an Android-based mobile application to manage attendance using QR codes. The backend infrastructure is supported by PHP and MySQL servers. The final product is designed to aid educational organizations in maintaining and tracking student attendance records efficiently.

System Overview

The proposed system operates as follows:

- **QR Code Generation and Scanning**: Each student receives a unique QR code, which is displayed during lectures. Students scan this code using their mobile devices to mark their attendance.
- **Identity Verification**: The system ensures accurate attendance recording by verifying student identities, reducing the chance of false registrations.
- **Data Management**: Attendance data is stored in a MySQL database and managed using PHP scripts, facilitating efficient data retrieval and management.

Comparison with Other Technologies

- **Biometrics**: Technologies like facial recognition and fingerprint scanning offer high security and accuracy but are complex and costly.
- **Bluetooth and RFID**: These technologies can expedite attendance recording but require similar time as QR code systems.

Implementation Details

The high-level implementation includes:

- **QR Code Display**: QR codes are shown at the start of each lecture.
- **Mobile Application**: Students use a mobile app to scan the QR codes.
- **Database Integration**: Attendance data is stored in a MySQL database, managed with PHP scripts.

Software Specifications

HTML

HTML (Hypertext Markup Language) is the standard markup language for creating web pages. It uses tags to structure and present web content. HTML tags define elements like headings, paragraphs, lists, links, and images, forming the backbone of web content. HTML allows the embedding of scripts to enhance functionality and interactivity.

CSS

CSS (Cascading Style Sheets) is a style sheet language used to describe the presentation of a document written in HTML or XML. CSS separates content from design, providing flexibility in presenting web pages. It enables the styling of elements such as layout, colors, and fonts, and adapts the presentation for different devices and screen sizes.

MySQL

MySQL, developed by Oracle Corporation, is a popular database management system used on the web. It supports standard SQL and is known for its speed, reliability, and ease of use. MySQL is capable of handling large databases and supports a wide range of platforms. Key features include:

- **Internals and Portability**: MySQL is written in C and C++, supports various compilers, and works on multiple platforms. It uses a multi-layered server design with independent modules.
- **Security**: MySQL provides a robust privilege and password system with host-based verification and encrypted password traffic.

- **Scalability and Limits**: MySQL can handle large databases with millions of records and supports up to 64 indexes per table.

CONNECTIVITY: Clients have multiple options for connecting to MySQL Server:

- **TCP/IP Sockets**: Clients can connect using TCP/IP sockets on any platform, offering a widely compatible and versatile connectivity option.
- **Named Pipes (Windows)**: On Windows systems within the NT family (NT, 2000, XP, 2003, or Vista), clients can connect using named pipes if the server is initiated with the --enablenamed-pipe option. Additionally, starting from MySQL 4.1, Windows servers support shared-memory connections with the shared-memory option enabled. Clients can connect through shared memory using the --protocol=memory option.
- **Unix Domain Socket Files (UNIX)**: On UNIX systems, clients can establish connections using Unix domain socket files, providing a streamlined and efficient connectivity method tailored for UNIX environments.

LOCALIZATION:

- **Multilingual Error Messages**: The server is capable of delivering error messages to clients in various languages, ensuring accessibility and comprehension for users across different linguistic backgrounds.
- **Character Set Support**: All data is stored in the selected character set, facilitating proper localization and ensuring that text data is accurately represented and displayed according to the chosen language or character encoding.

CLIENTS AND TOOLS:

- **Command-Line Programs**: MySQL offers various command-line programs like **mysqldump** and **mysqladmin** for performing database management tasks efficiently. These

utilities enable users to perform tasks such as database backup, administration, and maintenance from the command line interface.

- **Graphical Interface Tools**: MySQL provides graphical programs like MySQL Workbench, offering a user-friendly interface for database management tasks. These tools enhance usability and accessibility for users who prefer graphical interfaces over command-line interactions.

- **SQL Statements for Table Maintenance**: MySQL Server includes built-in support for SQL statements to check, optimize, and repair tables. These statements can be executed from the command line using the **mysqlcheck** client. Additionally, the **myisamchk** command-line utility allows fast operations on MyISAM tables.

- **Online Assistance**: MySQL programs offer online assistance through the **--help** or **-?** option, providing users with quick access to documentation and usage instructions directly from the command line interface. This feature enhances usability and helps users navigate the functionalities of MySQL tools effectively.

MySQL offers several compelling reasons for its usage:

1. **Leading Open Source RDBMS**: MySQL is one of the most widely adopted open-source relational database management systems (RDBMS), providing a cost-effective solution for businesses of all sizes.

2. **Ease of Use - No Frills**: MySQL is known for its simplicity and straightforwardness. It offers a user-friendly interface and easy-to-understand commands, making it accessible even for beginners.

3. **Fast Performance**: MySQL is optimized for speed, offering quick data retrieval and processing. It is designed to handle large volumes of data efficiently, making it suitable for high-traffic websites and applications.

4. **Robustness**: MySQL is a robust and reliable database management system, capable of handling concurrent transactions and ensuring data integrity even under heavy loads.

5. **Security**: MySQL offers robust security features, including encryption, user authentication, and access control mechanisms, to protect sensitive data from unauthorized access and malicious attacks.

6. **Multiple OS Support**: MySQL is compatible with various operating systems, including Linux, Windows, macOS, and UNIX, providing flexibility in deployment across different platforms.

7. **Free and Open Source**: MySQL is open-source software distributed under the GNU General Public License (GPL), meaning it is free to use, modify, and distribute, making it an attractive option for businesses seeking cost-effective solutions.

8. **Technical Support**: While MySQL is free to use, businesses can also opt for commercial support services provided by Oracle Corporation or third-party vendors, ensuring access to expert assistance and timely updates.

9. **Scalability**: MySQL is designed to scale efficiently, allowing businesses to handle growing amounts of data and users without sacrificing performance. It supports large databases with millions of rows and extensive file sizes, making it suitable for enterprise-level applications.

Overall, MySQL's combination of performance, reliability, security, and cost-effectiveness makes it a preferred choice for businesses and developers worldwide.

JavaScript serves as the scripting language for the web, playing a pivotal role in modern HTML pages. As a lightweight programming language, it offers versatility and ease of use. JavaScript code can

seamlessly integrate into HTML pages and execute across various web browsers. Its simplicity makes it accessible for beginners and facilitates rapid learning.

JavaScript is considered essential for web development due to its role in defining the behavior of web pages. Alongside HTML, which structures content, and CSS, which styles layout, JavaScript completes the trio of fundamental languages for web developers. It enables developers to create interactive and dynamic web pages, enhancing user experience and functionality.

JavaScript indeed offers a wide range of functionalities beyond just defining the behavior of web pages. It can manipulate HTML elements dynamically by deleting, creating, or copying them, allowing for dynamic content generation and modification. When embedded in HTML, JavaScript code consists of a sequence of statements executed by the web browser, enabling interactivity and responsiveness in web applications.
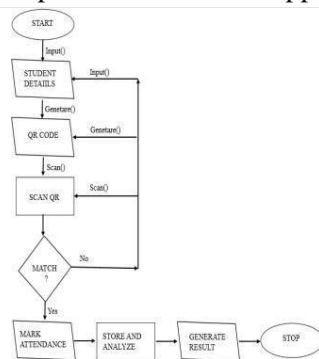

Figure 5. Flowchart of the application system

JavaScript statements serve as instructions to the web browser, directing it on what actions to take. For instance, a JavaScript statement may instruct the browser to write specific content, such as "Hello Dolly," into an HTML element identified by the id "demo."

Semicolons are used to separate JavaScript statements. Typically, you include a semicolon at the end of each executable statement. This practice helps ensure clarity and consistency in your code. Additionally, properties in JavaScript refer to the values associated with objects. Objects in JavaScript are collections of properties, which can often be modified, added, or removed. However, some properties may be designated as read-only, meaning they cannot be altered.

Servlets are Java program modules designed to run on the server side, processing and responding to client requests. They implement the Servlet interface, which allows them to interact with the web server and handle various tasks such as managing user sessions, processing form data, and generating dynamic content. Servlets are instrumental in extending the functionality of web servers with minimal overhead, making them an efficient and flexible solution for building dynamic web applications.
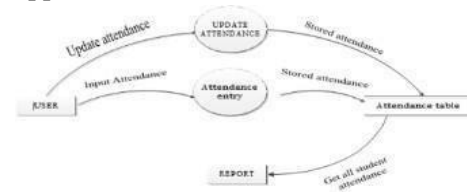

Figure 2. Data flow diagram

Indeed, a servlet serves as a bridge between the client and the server, operating on the server side to process incoming requests from clients. Servlets leverage request and response objects to efficiently handle HTTP requests and send corresponding data back to the client.

Given their integration with the Java language, servlets inherit all the features of Java, including high portability, platform independence, robust security mechanisms, and seamless integration with Java Database Connectivity (JDBC) for database operations. This inherent compatibility with Java makes servlets a powerful and versatile tool for developing dynamic web applications with enhanced functionality and reliability.

3. Testing

Testing is an essential process aimed at uncovering errors or faults within a work product. It involves systematically evaluating the functionality of software components, assemblies, or finished products to ensure they meet specified requirements and user expectations, while also avoiding unacceptable failures.

There exist several types of tests, each catering to specific testing requirements. These test types encompass a range of approaches and methodologies designed to verify different aspects of the software

system, ensuring its reliability, functionality, and performance align with intended standards and objectives.

4.1 - TYPES OF TESTING:

Unit testing is a crucial aspect of software testing that focuses on verifying the internal logic of individual program units. These test cases are designed to ensure that the internal code functions correctly and that inputs produce the expected outputs.

During unit testing, all decision branches and internal code flows are scrutinized to validate their correctness. It is conducted at the component level, testing specific business processes, applications, or system configurations.

Unit testing is typically performed after the completion of an individual unit and before integration with other components or units. It is considered a form of structural testing, as it requires an understanding of the software's construction and can be invasive in nature.

The primary goal of unit tests is to ensure that each unique path of a business process adheres to documented specifications and produces the expected results, thereby enhancing the reliability and robustness of the software.
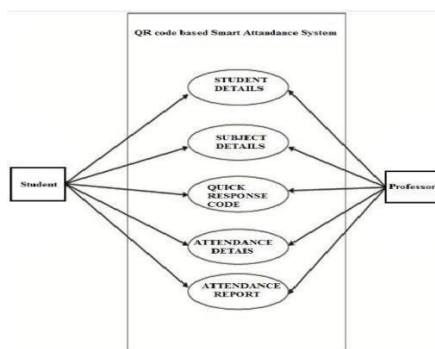

Figure 1. Use case diagram

Integration testing is a critical phase of software testing that focuses on testing the integration of individual software components to ensure they function cohesively as a single program. This testing phase verifies that integrated components interact correctly and produce the expected outcomes when combined.

Unlike unit testing, which focuses on testing individual units of code, integration testing evaluates the behavior of interconnected components as a whole. It is event-driven and prioritizes testing the basic outcomes of screens or fields within the integrated system.

Integration tests aim to demonstrate that while individual components may have been successfully tested in isolation during unit testing, they function correctly when integrated together. This testing phase specifically targets issues that may arise from the combination of components, such as data flow inconsistencies, communication errors, or interface mismatches.

By conducting integration testing, software development teams can identify and address integration-related issues early in the development lifecycle, thereby ensuring the overall reliability, consistency, and functionality of the integrated software system.

Functional tests are systematic assessments conducted to verify that the functions within a software application behave as intended according to both business and technical requirements. These tests ensure that the identified functions are available and perform correctly, the expected outputs are generated, and any interfacing systems or procedures are invoked as required.

Key aspects of functional testing include:

1. **Functions:** The functional tests exercise the identified functions within the software application. This involves testing various features, capabilities, and operations to validate their behavior and functionality.

2. **Output:** Functional tests validate that the application produces the expected outputs in response to specific inputs or actions. This includes verifying that the application generates correct responses, displays accurate

information, and performs necessary computations or transformations.

3. **Systems/Procedures:** Functional tests also verify the integration and interaction of the software application with other systems or procedures. This ensures that interfacing components or external dependencies are invoked correctly and that data exchanges occur as expected.

Functional testing is essential for validating the overall behavior and functionality of the software application from an end-user perspective. It helps ensure that the software meets the specified requirements and performs its intended functions accurately and reliably.

In the organization and preparation of functional tests, the focus is primarily on ensuring that all requirements, key functions, and special test cases are thoroughly addressed. This involves systematically covering various aspects such as:

1. **Business Process Flows:** Functional tests should cover the entire business process flow to ensure that all steps and interactions within the system are functioning correctly. This includes testing each stage of the process from start to finish, verifying the sequence of actions, and validating the expected outcomes.

2. **Data Fields:** Testing should encompass validation of all data fields within the application. This involves checking for data integrity, accuracy, and consistency, as well as ensuring that inputs are properly processed and stored.

3. **Predefined Processes:** Functional tests must verify the behavior of predefined processes or workflows within the application. This includes testing the functionality of built-in features, automated tasks, and standard procedures to ensure they perform as expected.

4. **Successive Processes:** Testing should also consider successive processes that occur as a result of specific actions or events within the application. This involves validating the flow of data and activities between different components or modules, ensuring smooth transitions, and detecting any potential issues or errors.

Before concluding functional testing, additional tests may be identified based on the effectiveness of current tests and any gaps or areas that require further examination. This iterative approach ensures comprehensive coverage and helps identify any potential defects or inconsistencies in the software application.

System testing ensures that the entire integrated software system meets requirements and tests a configuration to ensure known and predictable results. It focuses on process descriptions, flows, and integration points.

White Box Testing involves testing with knowledge of the inner workings, structure, and language of the software. It is used to test areas inaccessible from a black box level.

Black Box Testing is conducted without knowledge of the inner workings, structure, or language of the module being tested. Tests are derived from a definitive source document like specifications or requirements.

Unit Testing is typically conducted during the code and unit test phase, verifying individual components' functionality.

Test strategy and approach include manual field testing and detailed functional tests.

Test objectives include ensuring proper functionality of field entries, activation of pages from identified links, and timely responses without delays. Features to be tested involve verifying correct entry formats, disallowing duplicate entries, and confirming all links direct users to the correct pages.

Integration Testing verifies that integrated software components interact without errors, detecting failures caused by interface defects.

Test results indicated successful completion of all test cases without encountering defects.

Advantages of the system include more effective decision-making, efficient services, organized systems, and reduced paperwork. Limitations include the need for efficient storage and internet connection, as well as potential delays in service due to data ambiguity.

In conclusion, the system eliminates tedious attendance marking, saving time for both faculty and students.

Future scope includes integrating QR code systems with geolocation technology, tracking latecomers, integrating with other systems, and incorporating AI algorithms for improved accuracy in attendance tracking.

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